

Laws of Thermodynamics review for quiz next Wednesday

Zeroth Law - Heat flows from a hot object to a cold object until they are in thermal equilibrium, same temperature.

First Law of Thermodynamics - The change in thermal energy = heat added and the work done on an object. (energy is conserved)
eg. rub your hands, the work is converted into heat.

Second Law of Thermodynamics - Entropy (randomness) of a system tends to increase unless work is done on the system (energy source).
Entropy of the universe tends to increase.
eg. Your room gets messy unless you clean it.

1. A 50.0g lead bullet is moving at 500.0 m/s before it hits a steel plate and stops.
 - a) what is the kinetic energy of the bullet?
 - b) if all the kinetic energy goes into heating the bullet from 20.0°C, what is the final temperature and state of the bullet?
- $c_{\text{lead}} = 130 \text{ J/kg}^\circ\text{C}$ melting point = 327.5°C
 $H_f = 2.04 \times 10^4 \text{ J/kg}$ $c_{\text{molten lead}} = 140 \text{ J/kg}^\circ\text{C}$

2. Why is there order on Earth if the second law of thermodynamics is true?

3. How does a refrigerator work?

HW p260 CR 2.1-2.4
p262 AC 1, 3, 7, 8, 9

1. A 50.0g lead bullet is moving at 500.0 m/s before it hits a steel plate and stops.

a) what is the kinetic energy of the bullet?

$$E_k = \frac{1}{2} mv^2 = \frac{1}{2} (0.050\text{kg})(500\text{m/s})^2$$

$$0.5 \times 0.05 \times 500 \times 500 = 6,250.0$$

$$6.25 \text{ kJ}$$

b) if all the kinetic energy goes into heating the bullet from 20.0°C, what is the final temperature and state of the bullet?

$$c_{\text{lead}} = 130 \text{ J/kg}^\circ\text{C} \quad \text{melting point} = 327.5^\circ\text{C}$$

$$H_f = 2.04 \times 10^4 \text{ J/kg} \quad c_{\text{molten lead}} = 140 \text{ J/kg}^\circ\text{C}$$

$$Q = mc(T_f - T_i)$$

$$Q = 0.050 \times 130 \times (327.5 - 20) = 1,998.75$$

$$Q = mH_f = 0.050 \times 20400 = 1020.0 \text{ to melt the lead}$$

$$6250 - 1998.75 - 1020 = 3231.25$$

$$= mc(T_f - T_i) \quad \Delta T = 3231.25 / (0.05 \times 140) = 461.6071$$

$$327.5 + 461.6071 = 789.1071$$

so the final state is molten lead, the final

temperature is 789°C . (below the boiling point)

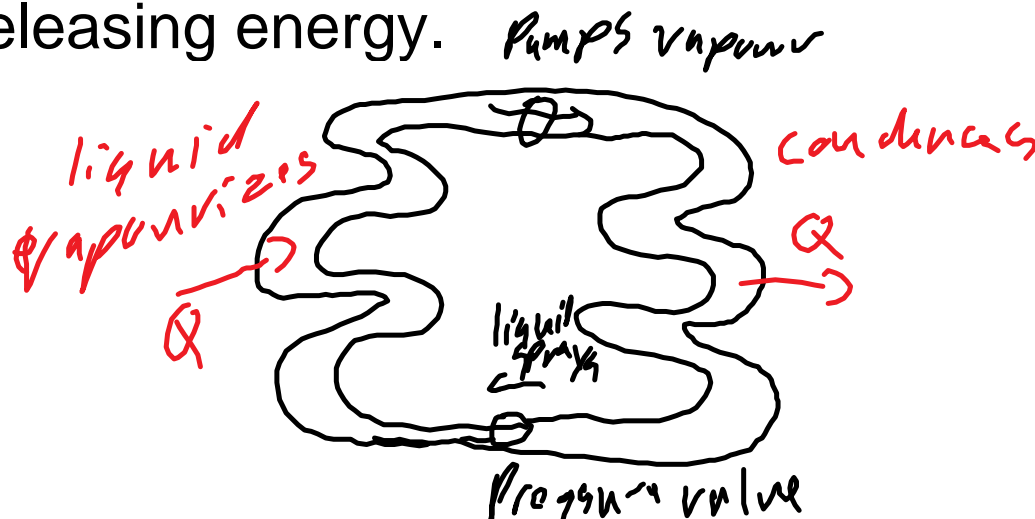
1. Why is there order on Earth if the second law of thermodynamics is true?

The sun is constantly adding energy to the Earth, doing work that can create order.

2. How does a refrigerator work?

Force a liquid to vapourize by putting it under low pressure (pump and a pressure valve) and it absorbs heat from cold things in your fridge.

The vapour is pumped to tubes outside the fridge, where it is under pressure and condenses, releasing energy.



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